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ABSTRACT

A combined lecture-problem workbook course in math and graphics for students entering the engineering program at Triton Community College was designed to allow them to progress at their own rate without a need for faculty lecture. The workbook places equal emphasis on descriptive geometry and graphics with the major areas covered broken into approximately 50 modules, each containing a statement of the topic, theoretical notes, and the method of solution. The modular approach has several advantages: (1) it certifies that all students have covered the same material and have been exposed to the basics in the field; (2) it offers flexibility for schools whose entering populations exhibit a variety of preparations or abilities; (3) it allows a greater degree of freedom for individual teaching styles among part-time faculty; and (4) it offers built-in accountability for administrative concerns. Sample problems are included. (MER)

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MODULAR SELF-PACED GRAPHICS AT THE COMMUNITY COLLEGE

by

Lia Brillhart

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MODULAR SELF-PACED GRAPHICS AT THE COMMUNITY COLLEGE

Dr. Lia Brillhart

Introduction

A self-paced modular course has been developed to meet the needs of students enrolled in a first semester three credit hour (six class hour) graphics course. A modular workbook covering descriptive geometry and engineering graphics is used in the course. The course is open-ended in that it requires a final project whose length and difficulty is dependent on student ability.

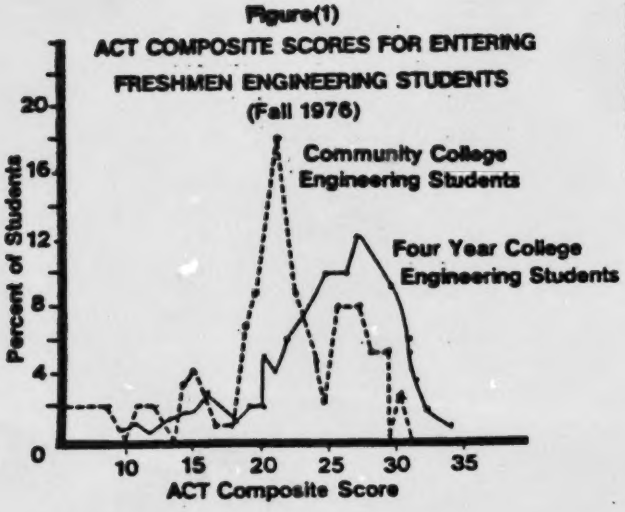
Problem Definition

Engineering graphics is generally a required course in the first semester of the engineering curriculum for which no prerequisites or entrance requirements exist. While general entrance requirements of major engineering schools screen students effectively, this is not the case in community colleges where all students declaring an engineering major are placed in graphics during their first semester.

Student preparedness for graphics can be judged on two criteria, math achievement and graphics background. It has been found that high math achievement, particularly experience with solid or analytic geometry influences descriptive geometry comprehension. A good background in high school drafting or graphics, or industrial experience, aids in "drafting" performance.

The variation of student background in math and graphics at an "open door" institution is vast, particularly in one having a large evening enrollment. Students' math backgrounds range from concurrent enrollment in remedial arithmetic (fractions, decimals, long division) to enrollment in differential equations (generally students switching majors from math or science). The difference in math background of Triton students, as evidenced by ACT scores is shown in Fig. (1).

Figure(1)
ACT COMPOSITE SCORES FOR ENTERING FRESHMEN ENGINEERING STUDENTS (Fall 1976)



The backgrounds in engineering drawing range academically from no high school graphics courses to a very comprehensive sequence of courses over a four year period. In terms of experiential background, a class often includes draftsmen with up to twenty years on the board, as well as students who have never drawn.

Solution

An attempt to teach such a diverse student body by the traditional lecture-workbook method rapidly proved to be futile. After consideration of the problem, it was felt that a self-paced modular course with multiple entrance patterns would allow each student to best apply his/her prior knowledge. Furthermore, it would free the instructor to do more individualized tutoring with students who had overall weak backgrounds.

Two methods, the individualized instruction approach presented by Ratledge[1] and the Self-Paced text by Scheerer[2] were considered. Ratledge's approach was rejected because of cost, while Scheerer's coverage did not fit the guidelines of the course covered at Triton. As a solution to the problem at the community college, a combined lecture-problem workbook was designed by Anderson and Brillhart[3] with the goal of allowing students to progress (without a need for

faculty lecture) at their own rate. The book placed equal emphasis on descriptive geometry and graphics. Major subject areas covered by the book are shown in Fig. (2).

Figure (2)

CONTENTS

I

01 Graphs
02 Linear Graphs
03 Semi-Logarithmic Graphs
04 Logarithmic Graphs
05 Bar Graphs
06 Pie Charts

II

10 Point in Space
20 Locate the Third View of a Point
30 Auxiliary View of a Point in Space
40 Bearing of a Line
50 True Length of a Line
60 Slope of a Line
70 Parallel Lines
80 Intersecting Lines
90 Point View of a Line
100 Perpendicular Lines
110 Perpendicular Lines - Two View Method
120 Shortest Distance from a Point to a Line
130 Shortest Distance Between Two Parallel Lines
140 Shortest Distance Between Two Skew Lines
150 Distance Between Two Skew Lines Parallel to a Third Line
160 Vertical Distance Between Two Skew Lines

III

170 Plane in Space (Strike)
180 Edge View of a Plane
190 Dip of a Plane
200 True Size of a Plane
210 Angle Between Two Intersecting Lines
220 Point in a Plane
230 Line in a Plane
240 Distance from a Point to a Plane
250 Visibility
260 Intersection of a Line and a Plane
270 Intersection of a Line and a Plane - Two View Method
280 Line Perpendicular to a Plane - Two View Method
290 Plane Perpendicular to a Line
300 Line Parallel to a Plane
310 Plane Parallel to Two Lines
320 Angle Between a Line and a Plane
330 Intersection of Two Planes
340 Intersection of Two Planes - Two View Method
350 Angle Between Two Planes
360 Angle Between Two Planes - Line of Intersection Given

IV

400 Isometric Projection
410 Isometric/Orthographic Drawing
420 Orthographic Projection
430 Orthographic Projection - Missing View
440 Isometric Drawing
450 Cabinet Drawing
460 Cavalier Drawing
470 Full Section
480 Half Section
490 Offset Section
500 Revolved and Removed Sections
510 Aligned Section
520 Broken Out Section

V

600 Dimensioning Techniques
610 Tolerancing

In writing this book, particular emphasis was placed on vocabulary and sentence length and complexity. The modules were written with a gradually increasing reading level required. Reading level was checked by the Fry[4] test.

The major areas covered in this material were broken into approximately 50 modules, each containing a statement of the topic, theoretical notes and the method of solution. A module and an associated typical problem are included as Fig. (3) through (6). The module included is among the first in the program and deals with the topic of true length of a line. The example is included to illustrate general format. The first page of each module, Fig. (3), states the topic, gives information and presents the problem for which a

Figure (3)

TRUE LENGTH OF A LINE - AUXILIARY VIEW METHOD

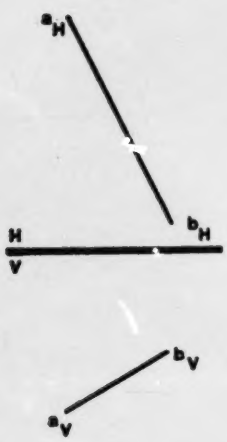
GIVEN: Front and top view of a line in space.

FIND: The true length of the line.

NOTE: When a line is parallel to any plane, its projection on that plane represents the true length of the line.

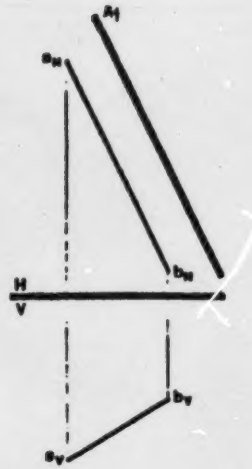
When a line is true length (T.L.) in a view, it is parallel to the reference line in the previous view.

METHOD:
1. Construct an auxiliary plane reference line (A) parallel to line ab in the top view.
2. Construct guide lines from points a and b in the top view, perpendicular to the auxiliary reference line, into the first auxiliary view.
3. Project points a and b into the first auxiliary view. (See projection of points to a plane.)
4. Connect points a and b. Line ab in the first auxiliary view represents the T.L. of the line.

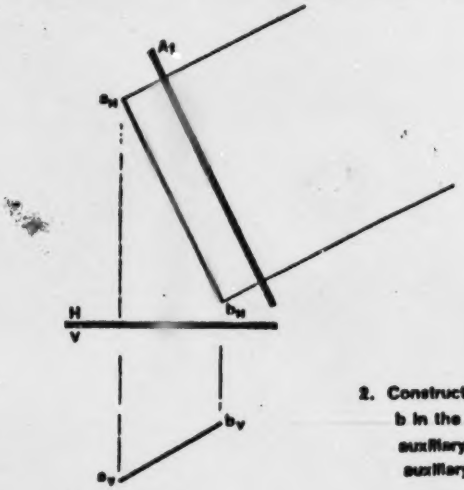


solution is to be found. Notes usually are included and deal with the theoretical basis for the solution, but may also indicate standard conventions. Subsequent pages, Fig. (4) and (5) repeat each step of the method and illustrate the operation by the indicated graphical procedure .

Figure (4)

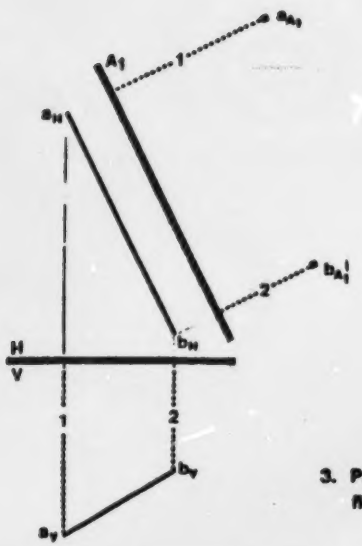


1. Construct an auxiliary plane reference line (A), parallel to line ab in the top view.

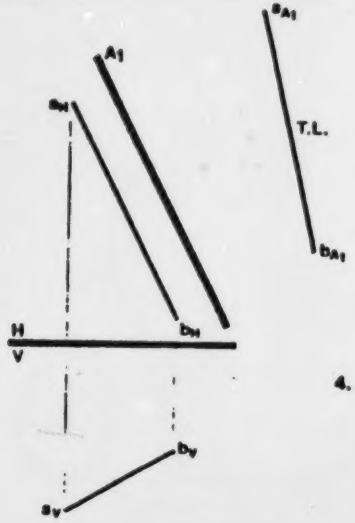


2. Construct guide lines from points a and b in the top view perpendicular to the auxiliary reference line, into the first auxiliary view

Figure(3)



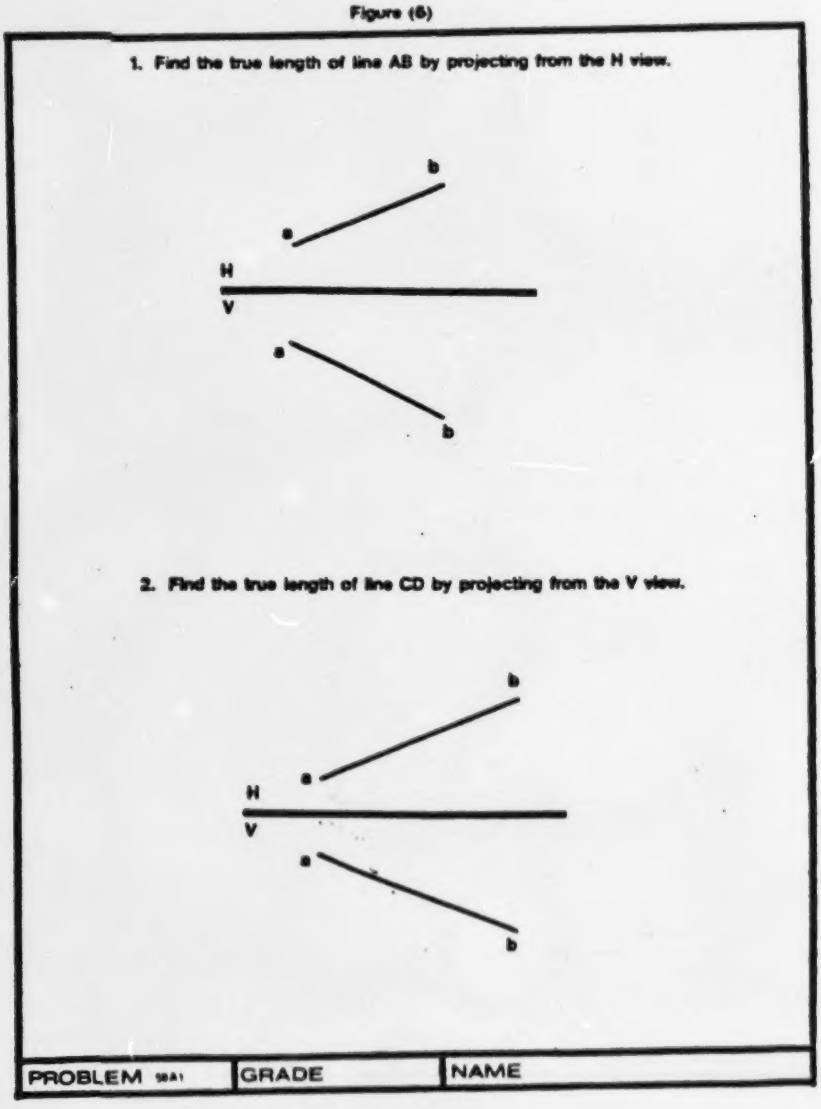
3. Project points a and b into the first auxiliary view.



4. Connect points a and b. Line ab in the first auxiliary view represents the true length line.

Problems are designed so that the first one or more problems directly test comprehension of the procedure, see Fig. (6).

Figure (6)



Subsequent problems test for more thorough understanding of the idea. The last problem is usually a "real life" engineering application. Problems also frequently test comprehension of previous modules, thereby integrating a series of modules. All modules are approximately equal in length. In order to complete the course in one semester, progress must be made at a rate of three to four modules per week.

Students are required to complete all modules and are tested by four exams, each covering roughly one quarter of the modules. Each hourly exam is given in class. Students who fail an exam may retake it by accessing the appropriate exam on a computer. In addition, students take a five hour comprehensive final exam. All plates are graded and errors discussed individually with students, with resubmission a requirement in the event that a major idea is not understood. Three tutors are available to students who need extended individual attention.

The course, besides demanding successful completion of modular requirements, also necessitates the completion of a project. The project is agreed upon by the student and instructor and is individualized for each student. The recent acquisition of a computer graphics terminal permits the incorporation of computer projects into the course.

Discussion

The combined project and modular required-sequence approach to graphics is particularly appropriate to a department where many teachers (particularly part-time instructors) are involved in graphics. In this institution, only one of seven sections of graphics is taught by a full-time instructor; all others are taught by engineers who work full-time in industry, and who teach one or two courses at the college. The modular portion certifies that all students have covered the same material and have been exposed to "the basics." With the project, the part-time instructors involve students in engineering problems from their industry, thereby making the project "real."

A modular approach has been used at Triton, in conjunction with a standard text, for three years. The first year it was used in half the sections to test its validity. All lectures were recorded on sound page, since it was felt that individualized instruction needed audio-visual backup. However, as the workbook

was improved, the use of sound page has decreased until now it is used only when students experience severe difficulties.

Conclusions

The method outlined is strongly recommended for schools with great variations of preparation or ability by entering students, although, it should be stated, that if completion is required in one semester, minimum monthly or weekly achievement standards must be set for self-paced material. Part-time faculty has been receptive to the method because degrees of freedom for individual teaching styles exist, but demands for preparation are not excessive. Administration approves of the method because of the built-in accountability. All students achieve a minimum standard of instruction independent of faculty teaching ability. Students enjoy both the structure of the demands (they immediately know what is expected of them), and the freedom of choice, in rate and point of entry.

References

1. Ratledge, Earl T., "Individualized Instruction in Freshman Graphics," Engineering Education, March 1970.

2. Scheerer, William F., Programmed Graphics, McGraw-Hill, 1967.

3. Fry, Edward, "A Readability Formula that Saves Time," Journal of Reading, Volume II, 1968.

4. Anderson, R. and L. Brillhart, A Modular Self-Paced Approach to Graphics, Triton College, 1973.

Biography

Dr. Brillhart received her B.M.E. at The Cooper Union in 1960 and her M.S. (1964) and Ph.D. (1967) at the Illinois Institute of Technology. She is a member of SESA, ASEE, AFT, SWE, ATW, STW, and Sigma Xi. Her publications are in the areas of experimental mechanics, engineering education, technical writing, and women's equity. Her present areas of research interest are CAI, team teaching, video education, and photoelasticity.